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An atomic wavelength standard has been acquired and a single-mode optical fiber network fabricated for the Pinon Flat Geophysical Observatory. These enhancements have greatly increased the precision of this unique facility.

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UNIVERSITY OF CALIFORNIA, SAN DIEGO  
Mark A. Zumberge, Principal Investigator

AFOSR 84-0247

15 Jul 1984 to 14 Nov 1985

An Optical Fiber Atomic Wavelength Standard  
for Pinon Flat Observatory

FINAL REPORT

We requested funds for the acquisition of an atomic wavelength standard and for the fabricating of a single-mode optical fiber network at Pinon Flat Geophysical Observatory. Several of the research programs at this unique facility depend on secondary wavelength standards for their highly precise measurement of crustal position, deformation, and motion. A fiber optic link to each of these instruments has allowed us to compare the wavelength of the light from the lasers with a centrally located absolute wavelength standard, thereby establishing the true accuracy of these state-of-the-art geodetic measurements. Owing to the cooperative nature of the research program at the observatory (utilized by more than 20 different research teams), we believe that our installation of this optical network is an important step towards the use of fiber optics and lasers in studies of the earth's crust.

The program as outlined in the proposal has been very successful and we have completed the major objectives. These included the acquisition of the equipment, its installation at the observatory, and the training of personnel to operate the equipment.

The first step was simply to procure the equipment necessary to determine the wavelengths of the lasers used in laser strain meters with respect to an absolute standard. For this we purchased an iodine stabilized laser, the optical components required to generate a beat frequency between this stabilized laser and the lasers with unknown wavelengths, and a spectrum analyzer to monitor and quantify the best signals.

The next step was to coherently transfer light from the lasers under test to the wavelength analyzing system. This is where we incorporated optical fibers. A small portion of the beam from each of the three strain meter lasers has been coupled into single-mode optical fiber. These carry the light to a nearby building which houses the iodine stabilized laser and the associated beat frequency optics.

An important and exciting outgrowth of this research initiated by funding from the DoD's instrumentation program is the beginning of a project to use the optical fibers to directly measure earth strain rather than simply using them as conduits of coherent laser radiation. With funding from both the U.S. Geological Survey and the National Science Foundation, we have begun an experiment to study the long term characteristics of optical fibers and are designing an optical fiber borehole strain meter.

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